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THE MODELING OF FACTORS THAT INFLUENCE COAST GUARD MANPOWER REQUIREMENTS

by

Kara M. Lavin

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Thesis Advisor: Ronald E. Giachetti
Co-Advisor: William D. Hatch

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This research, conducted at the request of the United States Coast Guard Manpower Requirements Determination Division, determines the data requirements for partial automation of the manpower requirements determination process. The Division currently uses a manual process to determine manpower requirements; however, the research proposes that many of the tasks can be partially automated to provide greater efficiency as well as capability. To accomplish this goal, the factors that contribute to determining manpower requirements are modeled in an entity-relationship diagram, and subsequently implemented in a relational database. These efforts confirmed that implementing a Manpower Requirements Determination Automated Information System would create greater efficiency in the United States Coast Guard's manpower requirements determination process. Additionally, due to the relative sameness of the United States Coast Guard and the United States Navy, the research recommends a continued relationship between the United States Coast Guard's Manpower Requirements Determination Division and the United States Navy's Manpower Analysis Center in support of future adaptation in regard to manpower requirements determination.

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Kara M. Lavin
Lieutenant Commander, United States Coast Guard
B.S., United States Coast Guard Academy, 2003
M.A., Bowie State University, 2009

Submitted in partial fulfillment of the
requirements for the degree of

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NAVAL POSTGRADUATE SCHOOL
December 2014

Author: Kara M. Lavin

Approved by: Ronald E. Giachetti
Thesis Advisor

William D. Hatch
Co-Advisor

William Gates
Dean, Graduate School of Business and Public Policy

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LIST OF ACRONYMS AND ABBREVIATIONS

ABCD	Accomplishment Based Curriculum Development
AMD	Activity Manpower Document
BSO	Budget Submitting Office
CIAO	Commandant Intent Action Order
COA	Course of Action
CRP	Capabilities Reconciliation Process
DCP	Data Collection Plan
DHS	Department of Homeland Security
ERD	Entity-Relationship Diagram
FMD	Fleet Manpower Document
HPT	Human Performance Technology
HR	Human Resources
IA	Individuals Account
MDM	Manpower Determinant Model
MER	Manpower Estimate Report
MFPU	Maritime Force Protection Unit
MFTs	Missions, Functions, and Tasks
MSMR	Mobilization Statement of Manpower Requirements
MRA	Manpower Requirements Analysis
MRD AIS	Manpower Requirement Determination Automated Information System
MRD	Manpower Requirements Determination
NAVMAC	Navy Analysis Manpower Center
NEOCS	Navy Enlisted Occupational Classification System
NMRS	Navy Manpower Requirements Systems
NOOCS	Navy Officer Occupational Classification System
OE	Organizational Element
PF&D	Personal Fatigue and Delay
POA&M	Plan of Action & Milestones
PWS	Performance Work Statement

ROC/POE	Required Operational Capability/Projected Operating Environment
SLMR	Staffing Logic and Manpower Requirements
SMD	Ship Manpower Document
SMRDP	Shore Manpower Requirements Determination Process
SMR	Statement of Manpower Requirements
SQL	Structure Query Language
SQMD	Squadron Manpower Document
TF	Total Force
TFMMS	Total Force Manpower Management System
TMMCA	TFFMS Micro Manpower Change Application
UIC	Unit Identification Code
USCG	United States Coast Guard
WAC	Work Adjudication Conference
WCA	Workload Constraints and Assumptions

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I. INTRODUCTION

A. BACKGROUND

The United States Coast Guard (USCG) faces a challenge getting the right people, in the right places, at the right times. According to the Government Accountability Office, this challenge was compounded when the USCG transitioned from the Department of Transportation to the Department of Homeland Security (DHS) in 2003, and subsequently as its role in homeland security expanded (United States General Accounting Office, 2003). Currently, the USCG is charged with the execution of 11 missions including ports, waterways, and coastal security; drug interdiction, aids to navigation, search and rescue, living marine resources, marine safety, defense readiness, migrant interdiction, marine environmental protection, ice operations, and other law enforcement. As such, the USCG is required to be agile and responsive to changing threat conditions in many different operating environments.

Determining manpower requirements and getting the right people, in the right place, at the right time, is an ongoing and complex process. The focal point is to identify the optimal number of people with the right knowledge, skills, and abilities. Too few or underqualified people may adversely impact safety, readiness, and mission execution. Too many or overqualified people may siphon funding from other priorities. Currently,

> the USCG lacks a system-wide methodology, an integrated set of applications, and common data warehouses needed to fully develop an effective and efficient manpower requirements engineering and management program. The lack of an objective control mechanism for determining the right number and skill mix of manpower creates inefficiencies in the ability to provide the right manpower to effectively meet the workload demands of our organization. (Papp, 2006, p. 1).

In May 2006, Admiral Thad W. Allen became the 23rd Commandant of the Coast Guard. The Admiral's goal for his tenure was to improve mission execution. He communicated his vision to the organization via Commandant Intent Action Orders (CIAO). Order number 8, "Human Resource Strategies to Support USCG Maritime Strategy," was published in August 2006. This order called for a process to ensure "the

right mix of human capital to support mission execution" (Allen, 2006, p. 1). Two specific initiatives outlined in the CIAO were "to establish methods to use measured workload data to define human capital requirements," and to "design and begin implementation of an automated information system that will allow individuals, unit commanders, and program managers to compare competencies held with competencies required by specific jobs or types of jobs for the purpose of defining the gaps" (Allen, 2006, p. 2).

CIAO 8 was directed to Human Resources, CG-1. In October 2006, the Human Resource Strategy and Capability Development Office, CG-1B, responded by establishing the Manpower Requirements Determination (MRD) Enterprise Development Team. "The principal goal of creating an MRD enterprise is to increase our ability to account for resources within the Coast Guard…" (Papp, 2006, p. 1). One of the MRD Enterprise Development Team's tasks was to "develop [a] centralized, web-enabled MRD data repository to capture work measurement data" (Papp, 2006, p. 6). In October 2008, the expectations of the MRD Enterprise Development Team were updated to include more specifically the development of a Manpower Requirements Determination Automated Information System (MRD AIS) and the creation of a temporary MRD database to house extant and future data (Breckenridge, 2008, p. 4).

The construction of a MRD AIS exceeded the capabilities of USCG employees so the service contracted an information technology company to build the system. "The primary goal of the MRD AIS project is to create a verifiable, repeatable, and defendable program that collects, measures, and analyzes the human capital needed to perform Coast Guard missions" (Commandant (CG-1B1), 2008a, p. 8). More specifically, the project's business objectives (BO) called for the system to:

- Reduce the process cycle time associated with workload demand evaluation, manpower requirements determination, and labor consumption measurement;
- Develop a standard process for determining the manpower requirements necessary to meet mission objectives;

- Increase the quality of work products associated with human capital decision support; and,
- Improve visibility of the USCG workforce, human resource demand, demand consumption, and demand cost information (Commandant (CG-1B1), 2008b, p. 14).

Also, the MRD AIS was to have three primary components:

- A central repository to house workload data;
- An optimization mechanism to determine the right amount and mix of manpower within an organization structure; and,
- A modeling and simulation process to generate alternatives to support the best business case for each alternative (Commandant (CG-1B1), 2008b, p. 17).

To date, the contractor-built MRD AIS nor any other MRD AIS has been integrated into USCG Manpower Requirements Analysis. No formal documentation exists as to why the MRD AIS was never adopted. Informal communication with the USCG Manpower Requirements Determination Division suggest that difficult interface, incomplete identification of factors that determine manpower requirements, and non-standard terminology have prevented the system from being integrated into Division operations.

Since the delivered MRD AIS is not being used, the USCG is continuing to use an antiquated and laborious process to determine manpower requirements. The process involves spreadsheets and manual calculations. These tasks can be easily completed and synthesized by a database which would translate to substantial time-savings and efficiency. Therefore, developing a robust MRD AIS remains a priority.

The development of a MRD AIS also has benefits beyond time-savings. For example, it would improve the standardization of manpower requirements across the service. It would alleviate resource managers from being influenced by local or programmatic needs, and eliminate similar unit types and requirements from being manned differently. Next, a MRD AIS would increase the transparency of manpower requirements at all levels and positively contribute to decision making. Specifically

increased visibility would not only inform staffing standards but recruiting, training, and advancement initiatives as well.

B. PURPOSE

The purpose of this study is to demonstrate the potential value in implementing a MRD AIS in the USCG. More specifically, the objective is to model the factors that contribute to determining manpower requirements in an entity-relationship diagram (ERD), and subsequently test the model using a relational database. The intent of a MRD AIS is to improve the accuracy of determining manpower requirements, alleviate time intensive manual processes, standardize manpower analysis across the USCG, increase transparency, bolster the service's ability to adapt to changing conditions, optimize manpower allocation, and identify alternative staffing solutions. Ultimately, the purpose of the study is to contribute to improved efficiency within CG-1B.

C. SCOPE AND METHODOLOGY

This project includes a literature review, an ERD, and a relational database for test and evaluation. The literature review is limited to a presentation and comparison of USCG and Navy processes for determining Fleet and shore manpower requirements. The comparison is made between the USCG and the Navy due to the similar nature of their mission requirements and aggregate resources for which requirements are determined. Industry, Air Force, Army, and Marine Corp processes are not reviewed. An ERD will be constructed; it will model USCG entities and attributes that contribute to determining manpower requirements. The model is original and not an extension of any contractor's work. A relational database will be built, and tested with simulated data. The primary method of testing the model and relational database will be via queries. The testing will be considered successful when a query produces a spreadsheet or table similar to products found in MRA Reports. No code was executed to perform mathematical computations or to yield summary information.

D. ORGANIZATION OF STUDY

This study is comprised of four chapters that include: Introduction, Overview of MRD, Description of Method and Analysis; and Summary, Conclusions, and Recommendations. Chapter II is the Overview of MRD; it is the literature review. Chapter III is the Description of Method and Analysis. It presents and explains the ERD and relational database. Simulated data is used to test the relational database, and the results are described. Chapter IV is the Summary, Conclusions, and Recommendations. This chapter is a compellation of the study's findings, and prescribes what may also be done to advance the implementation of an MRD AIS in the USCG.

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II. MRD OVERVIEW

This chapter summarizes the United States Coast Guard (USCG) and Navy processes for determining fleet and shore manpower requirements, and identifies similarities and differences between the processes. The literature reviewed is predominantly USCG and Navy publications. Note: the USCG Staffing Logic and Manpower Requirements Manuals, Volumes II through IV, which are reviewed as part of this project, are in draft form at this writing and may be subject to change prior to publication.

Proximity to Navy manpower subject matter experts, the similarity between the USCG and the Navy, and the presence of USCG members at the Navy Manpower Analysis Center (NAVMAC) motivated me to compare the USCG Manpower Requirements Determination (MRD) process with the Navy MRD process, as oppose to the process of another service. Further, the Navy process influenced the USCG process, so there is benefit to understanding the similarities and differences.

Regardless of the service, the focal point of manpower requirements determination is to get the right people, to the right places, at the right times, with the right skills. Accurate manpower requirements determination ensures a ready force, and safe and effective mission execution. Shortage or excess of manpower is the catalyst to compromised mission execution or waste, respectively.

A. USCG MRD

The name of the Coast Guard's process for determining manpower is the "Manpower Requirements Process"; it has three components. They are the Manpower Requirements Analysis (MRA) Process, the MRD, and the Capabilities Reconciliation Process (CRP). The MRA Process has three phases, Phase I, II, and III: Requestor Alignment, Mission Alignment, and HR System Alignment, respectively. The MRD is a product of the MRA Process. The CRP also has three phases, Phase IV, V, and VI: Program Alignment, Resource Alignment, and Establishment of Manpower Standards respectively. The Manpower Requirements Process, its components and phases are

shown in Figure 1. The focal point of this project, however, is the MRA process, which is described at length in the following paragraphs.

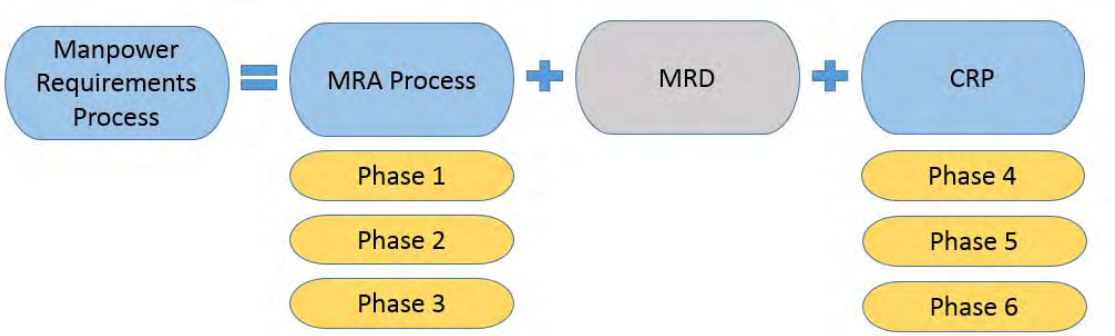

Figure 1. USCG Manpower Requirements Process.

1. MRA Levels

There are four levels of MRAs; listed in order of increasing analytical rigor, they are:

- MRA Level 1–Manpower Estimate Report (MER)
- MRA Level 2–Workload Consolidation
- MRA Level 3–Workload Validation
- MRA Level 4–Workload Observation.

The MRA Level is determined before the MRA begins. The MRA level is determined by a number of things including but not limited to the purpose of completing the MRA, the time available, the program requirement, and the OE's complexity. Regardless of the MRA Level, Phases 1–3 are completed for each MRA.

Although included as part of the hierarchy of MRAs completed in the USCG, a MRA Level 1–MER does not meet the analytical rigor of a true MRA. An MRA Level 1 is conducted when undefined mission requirements exist, for example, as a result of a system acquisition. An MRA Level 1, however, is key documentation for a subsequent MRA Level 2, 3, or 4 after mission requirements are determined and there exists baseline workload data.

As the degree of analytical rigor increases so does the level of intrusiveness into the organizational element (OE), a unit or a portion of a unit. MRA Level 2 is almost exclusively, and MRA Levels 3 and 4 begin with, a thorough review of policy documents and related resources. MRA Levels 3 and 4 use surveys and interviews of subject matter experts to validate work and collect workload data. In MRA Level 4, the MRA analyst visits the OE to observe directly the work and to collect workload data.

2. Before the MRA Process Can Begin

An MRA for fleet or shore OEs is initiated via an MRA request to the Manpower Requirements Determination Division, CG-1B4. The person, office, or command that files the MRA request is the "requestor." The MRA request is evaluated to determine what type of analysis will meet the needs of the OE for whom the MRA request was submitted. Once a mutual decision is made in regard to the best analysis method, the MRA request is added to the MRA Prioritization List managed by CG-1B4.

CG-1B4 does not have enough resources to complete every MRA request, nor the resources to complete the MRAs they commit to without contractor support. Whether an MRA is completed by organic or contracted resources depends on available funding, MRA priority, OE size and type, timeline, etc.

The final actions before Phase 1 begins are assignments of MRA personnel, and the completion of the Performance Work Statement (PWS). Once it is decided that a particular MRA will be completed, a team will be assigned if the MRA is to be completed with organic resources, or a team leader will be assigned to act as a project manager if the MRA is to be completed with contracted resources. Regardless, if organic or contracted resources are completing the MRA, a PWS is completed. A PWS is essentially a contract, describing what products and services will be delivered. When a contractor is completing the MRA, the PWS is fiscally binding and guides the MRA throughout the entire process.

3. Phase I–Requestor Alignment

Phase I, Requestor Alignment, is simple. It begins with the Alignment Meeting and concludes upon the submission of the Alignment Report. The Alignment Meeting is the forum where OE representatives meet with the respective CG-1B4 Analysis Team and exchange expectations. At a minimum, goals, objectives, and timeline are discussed. The required Alignment Report captures relevant project information and concludes Phase I.

4. Phase II–Mission Alignment

Phase II, Mission Alignment, is much more involved than Phase I. Phase II includes the identification and measurement of work, the recognition of assumptions and constraints, and the application of allowances. To help clarify the process, Phase II has guiding principles and core assumptions that direct the Phase.

Three of the four guiding principles are particularly notable and set the tone for the MRA. The first is that "The MRA process shall be free of political, budget, strategic, or mission prioritization constraints…" (Commandant, 2014, p. 3.F.3.a). The MRA should figuratively be executed in a vacuum as if only the work exists, and the analyst is determining for the first time what manpower is required.

The second notable guiding principle is "MRD analysts shall identify and categorize all work associated with the OE… but shall only analyze the OE's adjudicated work requirements" (Commandant, 2014, p. 3.F.3.a). Work requirements that are not adjudicated are not directed by extant data resources, organizational directives or publications. An example of work that may not be adjudicated is an extra daily safety patrol executed by a USCG station. This patrol is not a requirement, and is above and beyond what is expected of the station. In this example, it also surpasses what can routinely be executed by a single watch section, so the Commanding Officer directs an additional boat crew to be added to each watch section. This increased patrol posture again is not a requirement so will not be identified as work during an analysis. Therefore, the USCG station will not receive additional manpower to execute the additional daily safety patrol. OE leadership should be careful not to obligate itself to work that cannot be

adjudicated as additional manpower will not be provided to facilitate the completion of these tasks.

The third notable guiding principle is “MRD analysts shall identify an audit trail that can be easily traced,” and the “MRD will reflect the minimum manpower, minimum pay grade, and competency requirements necessary to perform the work” (Commandant, 2014, p. 3.F.3.a). This principle alleviates bias by directing a process with a clear standard that yields results that are verifiable, repeatable, and defensible.

Guiding principles and core assumptions in place, Phase II begins with the Data Collection Plan (DCP). It is a tool to organize the data collection, and help set the sponsor and OE’s expectations. The DCP includes the type of information to be collected, the method(s) used to collect the information, the personnel required to support the information collection, and the associated logistics. Information collection methods include work sampling, operational audit, interview, and survey. “The DCP is made up of a series of tables that list interview subjects, extant data sources, electronic data sources, and other sources of information particular to the OE being studied” (Commandant, 2010a, p. 3-2).

The Work Matrix, also a series of spreadsheets, is the data repository for collected work and workload information during an MRA. It contains a significant amount of information about each task including task description, type, class, reference, frequency, count, etc. The Work Matrix is the foundation for future analysis including modeling and options development. Work and workload can alternatively be recorded in an Operational Audit or in Task Lists.

Once the MRA team identifies work and workload, their findings are adjudicated during the Work Adjudication Conference (WAC). This “is an iterative back-and-fourth discussion between the requestor and MRA team” (Commandant, 2014, p. 3.F.3.c.4.). Gaining concurrence in regard to the information recorded in the Work Matrix, and subsequently agreeing on the assignment of competencies and major accomplishments to tasks are focal points of the WAC. Results from the WAC are documented in a Work Report that capture the requestor’s, the OE’s, and the MRA team’s collaborative efforts.

Workload constraints and assumptions (WCA) must also be accounted for when identifying work and workload information. Assumptions and constraints influence how work is identified, measured, and distributed. For example, a constraint may dictate a specific rank to whom a particular task should be distributed. The product that captures workload constraints and assumptions as well as total workload requirements is the WCA Report. It is submitted during Phase II as a follow-up to the Work Report, but the information is not applied until Phase III.

Phase II ends with the application of allowances. Allowances account for time members are at work but not accomplishing their specific workload. Allowances that may be applied are Personal Fatigue and Delay (PF&D), Training, Make Ready/Put Away, and Corrective Maintenance Ratio (Commandant, 2014, p. 3.F.3.c.6.). For example, these allowances account for a member's personal needs, training, information requirements, and preparation and clean up before and after maintenance, etc. Allowances positively contribute to the accuracy of determining manpower requirements. They alleviate distributing more work, than what can reasonably be achieved, to any one position.

5. Phase III–Human Resources System Alignment

Phase III, Human Resources (HR) System Alignment, is centered on modeling the information collected in the previous phases and yielding alternative staffing options. Phase III also includes an MRA Options Report, an MRA Manpower Option Selection Meeting, and an MRA Report. The publication of the MRA Report ends Phase III and the MRA.

Until Phase III the requirements determination process for fleet and shore is the same. The process diverges at modeling. Fleet requirements are determined by the Navy Manpower Requirements System (NMRS), and shore requirements are determined using the Manpower Determinant Model (MDM). NMRS "utilities a 'building block' process wherein the categories of workload and watchstanding requirements are accumulated and processed to form the minimum billet requirements" (Commandant, 2014, p. 3.F.4.b.). "The MDM captures all work, organizes tasks by major accomplishment, calculates workload, and distributes work based on the minimum pay grade necessary to complete

the work" (Commandant, 2014, p. 3.F.4.a.). Despite the different modeling methods, a common business rule is that manpower is determine to a minimum.

Results of the modeling, namely alternative staffing options, are documented within an MRA Options Report. The MRA Options Report not only details alternative staffing options, but also provides analysis in regard to capability and capacity limitations and requirements. Before the MRA team makes the MRA Options Report available to the requestor, it is submitted to MRD partners and stakeholders to confirm the viability of each staffing option. Following partner and stakeholder review, the MRA Options Report is made available to the requestor.

The MRA Options Report is discussed at length at the Manpower Option Selection Meeting. This meeting is the requestor's opportunity to discuss the different staffing options with the MRA team, ask questions, and identify discrepancies. Most notable at this meeting, the requestor selects its preferred staffing alternative, and it is this choice or MRD that is captured in the MRA Report. Upon submission of the MRA Report, Phase III and the MRA process are complete.

Although the MRA process is not complicated, it is lengthy and requires several meetings and reports. The MRA Phases, required meetings and reports are summarized in Figure 2.

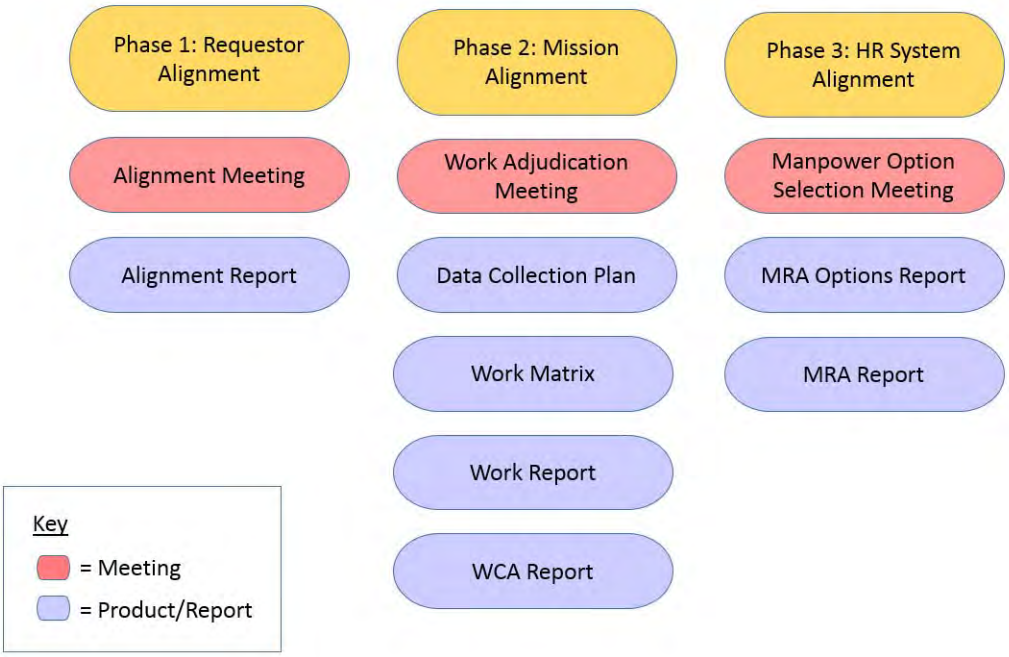

Figure 2. MRA Phases, required meetings and reports.

B. NAVY MRD

The Navy determines four types of manpower requirements: Fleet, shore, Individuals Account (IA), and Outside Navy. Only Fleet and shore requirements will be reviewed in this research. Regardless of the type of manpower requirement, the definition is the same:

> Manpower requirements define the number of personnel required to perform the Navy's work and deliver the specified capability. Each manpower requirement equates to a specific manpower space which is assigned qualifiers that define the duties, tasks, and functions to be performed and the specific skills and skill level required to perform the delineated functions. (Office of the Chief of Naval Operations, 2007, p. 1-1)

Despite the type of requirement, Navy manpower requirements reflect the minimum quantity and quality of work by occupation to meet mission requirements. "These two factors are commonly paired together as 'quan/qual'" (Office of the Chief of Naval Operations, 2007, p. 2-2). Quantity is the number of manpower requirements to meet mission requirements. It is calculated using Navy Standard Work Weeks. Quality is

the occupational knowledge, skills and abilities that are required to execute mission requirements. The parameters for quality are found in the Navy Enlisted Occupational Classification System (NEOCS) described in the Navy Military Personnel Manual 18068F, and the Navy Officer Occupational Classification System (NOOCS) described in the Navy Military Personnel Manual 15839I.

1. Fleet Requirements

Fleet manpower includes requirements for ships, squadrons and other deployable units. Required Operational Capability/Projected Operating Environment (ROC/POE) is the principal resource that directs mission requirements that translate to work and subsequently manpower requirements. Some of the other sources that influence Fleet manpower requirements are Navy Training Systems Plans and Activity Manpower Document (AMD) Change Requests.

The determination of all Fleet manpower requirements is centralized at NAVMAC. NAVMAC (N121) is overseen by OPNAV N12, the Total Force Requirements Division. Teams from NAVMAC visit units to collect, assess, and validate workload. Fleet workload is dominated by watch standing. Workload information, specifically workload hours, are inputted into the Navy Manpower Requirements Systems, and paired with occupational knowledge, skills, and abilities to further quantify and qualify manpower requirements. NMRS produces a recommended manpower mix based on the determined and validated workload information. Next, workload and manpower information is entered into the Total Force Manpower Management System (TFMMS). TFMMS is a data repository, and "the single, authoritative database for Total Force manpower requirements, and active duty MPN/RPN [Military Personnel Navy/Reserve Personnel Navy] manpower authorizations and end strength" (Office of the Chief of Naval Operations, 2007, p. B-18).

The Fleet Manpower Requirements Determination Process yields one of three documents at the conclusion of the process. The type of document produced depends on the unit evaluated. The potential documents are: the Fleet Manpower Document (FMD),

the Squadron Manpower Document (SQMD), or the Ship Manpower Document (SMD). These documents capture fleet manpower requirements by unit class.

Once programmed funding is applied to Fleet Manpower Requirements an AMD is produced. An AMD is "the qualitative and quantitative expression of manpower requirements (military, civilian, and contractor) and authorizations (military) allocated to a naval activity to perform the assigned MFTs [Missions, Functions, and Tasks] or ROC/POE" (Navy Manpower Analysis Center, 2000, p. M-1). As the definition suggests, this document differs from the FMD, SQMD, and SMD in that it captures manpower requirements and authorizations. The AMD reports manpower requirements by Unit Identification Code (UIC) and notates their funded or unfunded status. The Fleet Manpower Requirements Determination Process is summarized in Figure 3.

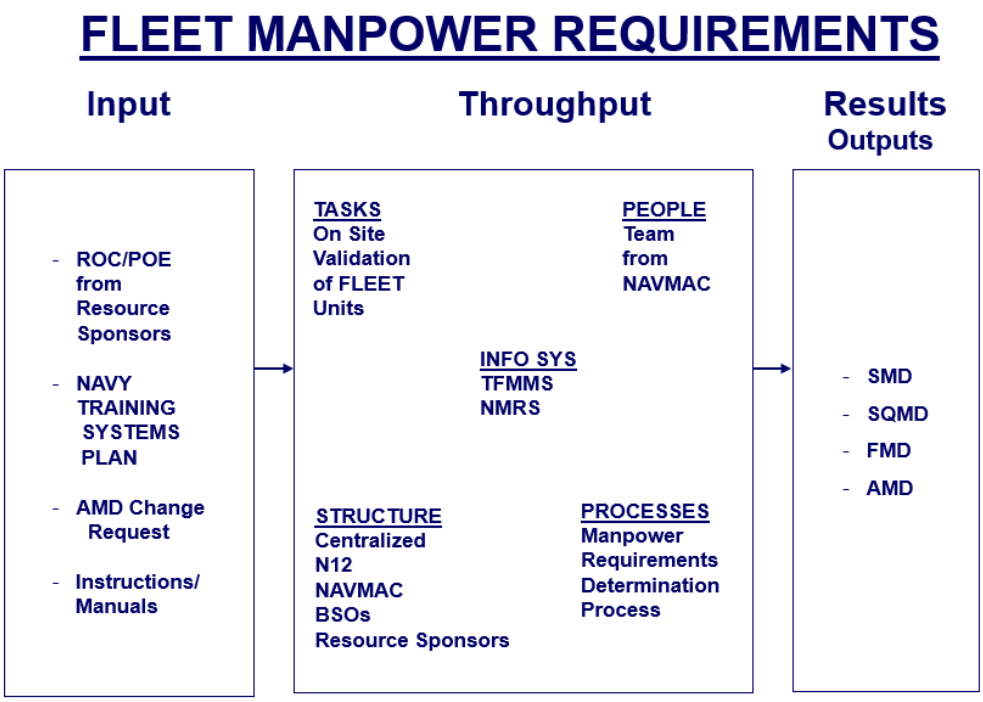

Figure 3. Navy Fleet Manpower Requirements (from Hatch, 2013).

2. Shore Requirements

Shore manpower requirements include activities that are not governed by ROC/POE, and are not IA or Outside Navy requirements. “Navy shore manpower requirements shall be based on directed Missions, Functions, and Tasks (MFTs)” (Office of the Chief of Naval Operations, 2007, p. 2-2). Shore manpower requirements are also influenced by AMD Change Requests and PWSs.

The Shore Manpower Requirements Determination Process (SMRDP) is decentralized. 34 individual Budget Submitting Offices (BSO) determine manpower requirements for their respective constituency. BSOs are made up of military, civilian, and contract personnel.

As a result of the decentralization of the SMRDP from BSO to BSO the process is not standardized. Similar to NAVMAC’s analysts, BSO personnel visit various units to collect, assess, and validate workload, however, workload measurement methods vary. Two popular methods are Op Audit and Work Sampling, which are based in statistics. “Op Audit is a work measurement tool in where work-hours required to accomplish defined categories, tasks, and subtasks of work within a work center/organizational component are derived by identification and summation of frequencies of occurrence multiplied by their unit times” (Navy Manpower Analysis Center, 2000, p. 5-1). Work sampling is based on the notion that random samples from a large population will reflect the characteristics of not only the sample but the population.

Regardless of the workload measurement method used, results are inputted into TFMMS. Since BSOs are decentralized and TFMMS is the repository for significant data that informs resource decisions, not all BSOs have the direct capability to change TFMMS. Instead they have access to the TFFMS Micro Manpower Change Application (TMMCA) which feeds TFFMS.

The Shore Manpower Requirements Determination Process yields a Statement of Manpower Requirements (SMR) during peacetime and a Mobilization Statement of Manpower Requirements (MSMR) for wartime.

> In general terms, the analyst develops the SMR/MSMR by calculating quantitative and qualitative manpower requirements based on work measurement and methods improvement data. The SMR/MSMR will reflect the skill and manpower mix requirements needed to support the activity's directed MFTs and associated workload. (Navy Manpower Analysis Center, 2000, p. 1-5)

The SMR and the MSMR reflect requirements only. The AMD follows the associated SMR and the MSMR. Similar to the Fleet Manpower Requirements Determination Process, the AMD reflects requirements and authorizations. The SMRDP is summarized in Figure 4.

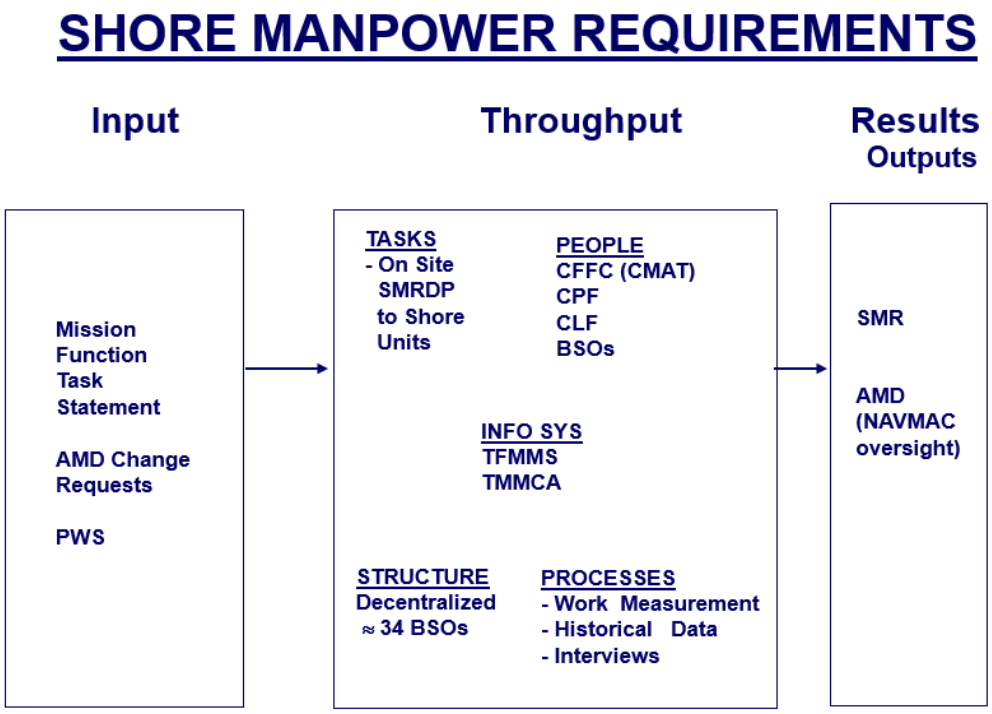

Figure 4. Navy Shore Manpower Requirements (from Hatch, 2013).

C. CHAPTER SUMMARY

The USCG and Navy share the objective to get the right people, to the right places, at the right times, with the right skills. Accurate manpower requirements reflect the standard for a ready force, and safe and effective mission execution. In both services mission requirements drive manpower requirements, and manpower requirements are

determined to a minimum quantity, to minimum pay grades, and to minimum competencies.

The USCG and Navy processes for determining manpower requirements are also similar. In fact, the USCG has adopted many Navy processes as its own. For example, the USCG uses NMRS to model Fleet Manpower Requirements. The USCG is able to use Navy products because the nature of work between the services is comparable.

As similar as the USCG and Navy processes for determining manpower requirements are some fundamental differences exist. For example, the Manpower Requirements Determination Division, CG-1B4 is the authority for Fleet and shore USCG MRDs, whereas the Navy's organization is significantly decentralized. NAVMAC is the authority for Fleet manpower requirements, and 34 individual BSOs are the authorities for shore manpower requirements.

Meeting twenty-first century challenges start with accurate manpower requirements determination. There is benefit to the USCG and the Navy remaining appraised of each service's best practices and lessons learned. Exchange between the services will contribute to optimizing their respective manpower requirements determination processes.

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III. DESCRIPTION OF METHOD AND ANALYSIS

The United States Coast Guard (USCG) either completes Manpower Requirements Analyses (MRA) organically with Active Duty and civilian members using a series of spreadsheets, or contracts them out. This is inefficient, because it is costly, untimely, lacking transparency and standardization, etc. The vision to improve the Manpower Requirements Process includes a new or revised Manpower Requirement Determination Automated Information System (MRD AIS) with data repository, optimization, and modeling and simulation capabilities.

The foundation of a MRD AIS and many process automation systems is an entity-relationship diagram (ERD) and a subsequent relational database. The relational database is the data repository, however, queries can be run within the relational database that produce tables similar to tables found in MRAs. The query capability is a source of efficiency, and will alleviate Manpower Requirements Determination (MRD) team members from manually drafting these tables.

The scope of this project includes the ERD, a relational database, and the verification and validation of the ERD via testing the relational database. A description of these products are found in the following paragraphs. Overall, this project demonstrates fundamentally the efficiency that may be gained by implementing this or a similar relational database.

A. MODELED FACTORS THAT CONTRIBUTE TO DETERMINING MANPOWER REQUIREMENTS

Accurate manpower requirements determination relies on the thorough identification and consideration of the factors that influence manpower requirements. For example, although members are at work for approximately 8–12 hours, they do not complete 8–12 hours' worth of work. Aside from at least one break for a meal during that time, members need breaks to mitigate fatigue, use the bathroom, etc. Therefore, it is important to determine how much time members actually spend working while they are at work. Time away from work as a result of dental and medical appointments, drills,

physical fitness, training, etc., also need to be considered. If these interruptions are not accounted for with "allowances," an entity in the ERD, more work will get distributed to a member than what he or she can actually complete. This example illustrates that failing to be thorough and specific in identifying factors that contribute to determining manpower requirements could significantly skew an MRD, and underestimate the quantity of members required to complete a prescribed amount of work or mission.

Incomplete identification of factors that influence manpower requirements not only impact the quantity of members determined but the quality of members determined as well. As described in the Navy MRD section, this is quan/qual, also known as "fill and fit." Quantity is synonymous for fill, and quality is synonymous for fit. An example for fit is the consideration of competencies. If a small boat station has boats with outboard engines, and the only assigned Machinery Technicians assigned have not been to the outboard engine school and only have experience with inboard engines, this degrades the unit's assets' operational availability and ultimately the unit's overall readiness.

Thorough identification of factors that influence the quantity and quality of manpower is imperative to accurate MRAs and MRDs. To be as thorough as possible in determining these factors, the USCG Staffing Logic and Manpower Requirements (SLMR) Manuals, Volumes I–IV; associated job aids and templates, and recent MRAs for the following organizational elements: Judge Advocate General (JAG) Program, Maritime Force Protection Unit (MFPU), Regional Dive Locker Pacific, and WTGB 140' (Bay) Class Icebreaking Harbor Tug were reviewed.

To help identify the factors that influence manpower requirements, nouns that describe people, work or workload, and organization were the focal point. In regard to people, nouns and adjectives including but not limited to competency, position, rank, rate, and work week availability were brainstormed. For work; allowances, assumptions, constraints, major accomplishments, and tasks were compiled. For organization; department, division, section, and team was recorded. A complete list of factors can be found in Appendix A.

A significant challenge in identifying the factors that contribute to determining manpower requirements was non-standard terminology. Language in the MRAs deviated from the language used in the SLMR Manuals (note: Volumes II–IV were in draft form), and further language in the MRAs deviated from one another. Therefore, it was difficult to determine what factors were synonymous with one another, and what factors were different enough that they should have a unique entity or attribute. A catalyst of the non-standard terminology may be that different sources, two different contractors or the USCG, which completed the reviewed MRAs.

A particularly interesting example of non-standard terminology is the use of "task" and "work item," as well as "category" and "major accomplishment." The impetus for the USCG to group tasks into major accomplishments was derived from the *Navy Total Force Manpower Requirements Handbook* (Commandant, 2014). The handbook, however, uses the term "category" while the USCG uses "major accomplishment." Based on informal communications with the USCG MRD Division, the USCG uses major accomplishment to standardize its language with USCG Human Performance Technology (HPT) divisions that use terminology consistent with the Accomplishment Based Curriculum Development (ABCD) system founded by Joe Harless. That said, it appears standardization with HPT divisions stopped short, because the USCG is using work item vice task. This is contradictory as task is consistent, and work item is not consistent with the ABCD system. Further exacerbating the issue is that category and major accomplishment are sometimes used synonymously, and sometimes category is used in other contexts. Throughout this project, major accomplishment and task are used consistently and are distinct from any other entities and attributes.

B. ENTITY-RELATIONSHIP MODEL

The ERD was drafted using the process outlined in *Design of Enterprise Systems - Theory, Architecture, and Methods* as a precursor to the relational diagram (Giachetti, 2010). A complete draft of the ERD is located in Appendix B. Microsoft Visio 2010 was used as the tool to design the ERD. The program is user friendly. The most helpful feature was that when relationships were established between two entities, the primary

key would automatically migrant from the parent entity to the child entity as a foreign key. The most challenging feature was changing the crow's foot notation. Namely once two entities were related and the relationship was determined to be incorrect, it was difficult to edit the relationship type. Later when entering the model in access, the difficulty editing the relationship type was often an indication that an associative entity was required.

Although relationships, not order, are what drive an ERD, the ERD was drafted sequentially following the MRA process. The process started with the entity, Requestor, and finished with the entity, Option. While the ERD was drafted, nouns describing people, work or workload, and organization continued to be the focal points. In the following paragraphs, the ERD is discussed in greater detail and references are made to the ERD by entity.

Entities that provide background information including the MRA request, the MRA team, and the MRA are shown in Figure 5. The entities, Requestor and MRARequest, and their respective attributes resemble the information found in USCG form 5310, The MRA Request. Not only is this information important, but the existence of these entities and attributes will contribute to transitioning the MRA request process from a manual to an electronic process.

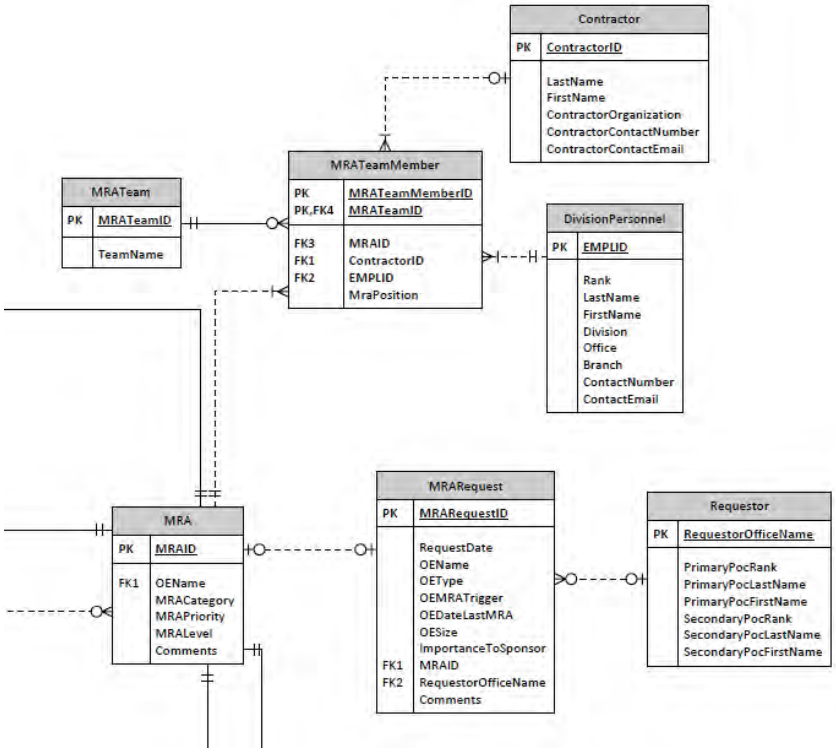

Figure 5. Background Information including MRA, MRARequest, and MRATeam

The ERD reflects sources of task and workload information. In this model, data is collected from reference documents including but not limited to Department of Homeland Security (DHS), USCG, and program documents, and via interviews and surveys as shown in Figure 6. Interview and survey information is found in a series of entities including Interview, InterviewQuestion, InterviewAnswer, Survey, SurveyQuestion, SurveyAnswer, and SurveyRespondent. Having a repository of interview and survey questions will alleviate the MRA team from drafting original questions for each MRA, yet provide the MRA team flexibility to tailor the interviews and surveys to different organizational elements. Having a repository of interview and survey answers will provide invaluable, historical perspective that may yield broader manpower requirement conclusions.

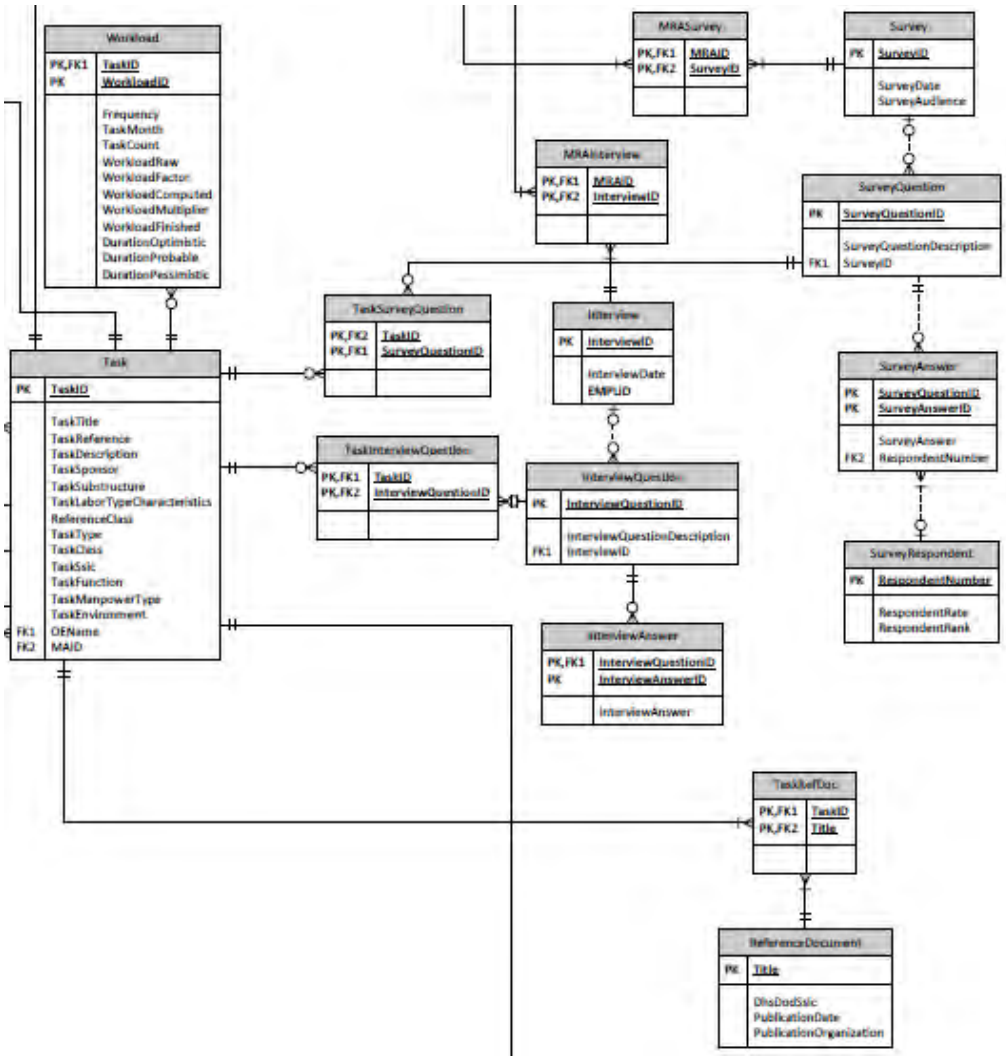

Figure 6. Sources of Task and Workload Information

People information is found in the Position, Rate, and Rank entities as shown in Figure 7. The Position entity describes the required positions based on the MRA. Its primary key is PositionID. Position and PositionID are separate and distinct from positions on the Personnel Allowance List (PAL) and its respective position numbers. Within the entity, Position, there is a binary attribute, PresenceOnPAL. If a similar position is determined to be required as there already exists on the PAL, then the binary response recorded in PresenceOnPAL is yes. If the binary response is yes, then the PALPositionNumber will be recorded to facilitate a comparison between what is required and what exists.

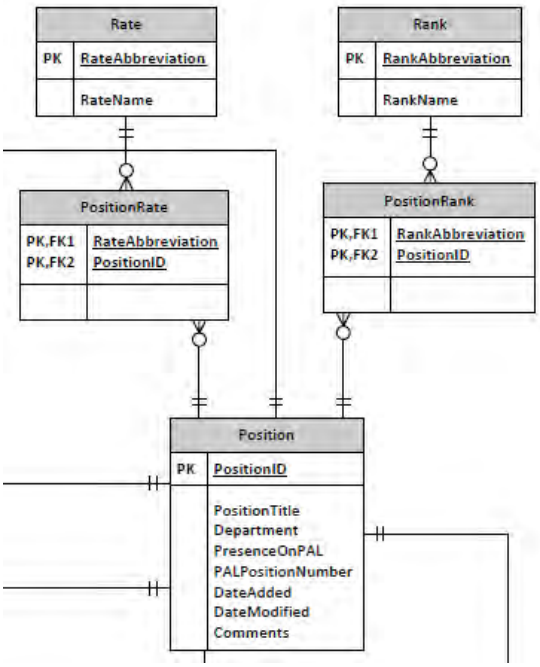

Figure 7. People Information

Work or workload information is found in the ERD in the Task, Competency, Workload, MajorAccomplishment, Constraint, Assumption, and WorkWeekAvailability entities as shown in Figure 8. As you would expect, the Task entity appears to be the central entity of the ERD. Originally, the ERD was drafted with the workload attributes as part of the Task entity so it was previously even more dominate than it is now. Workload attributes were separated from the Task entity to make the spreadsheets more manageable.

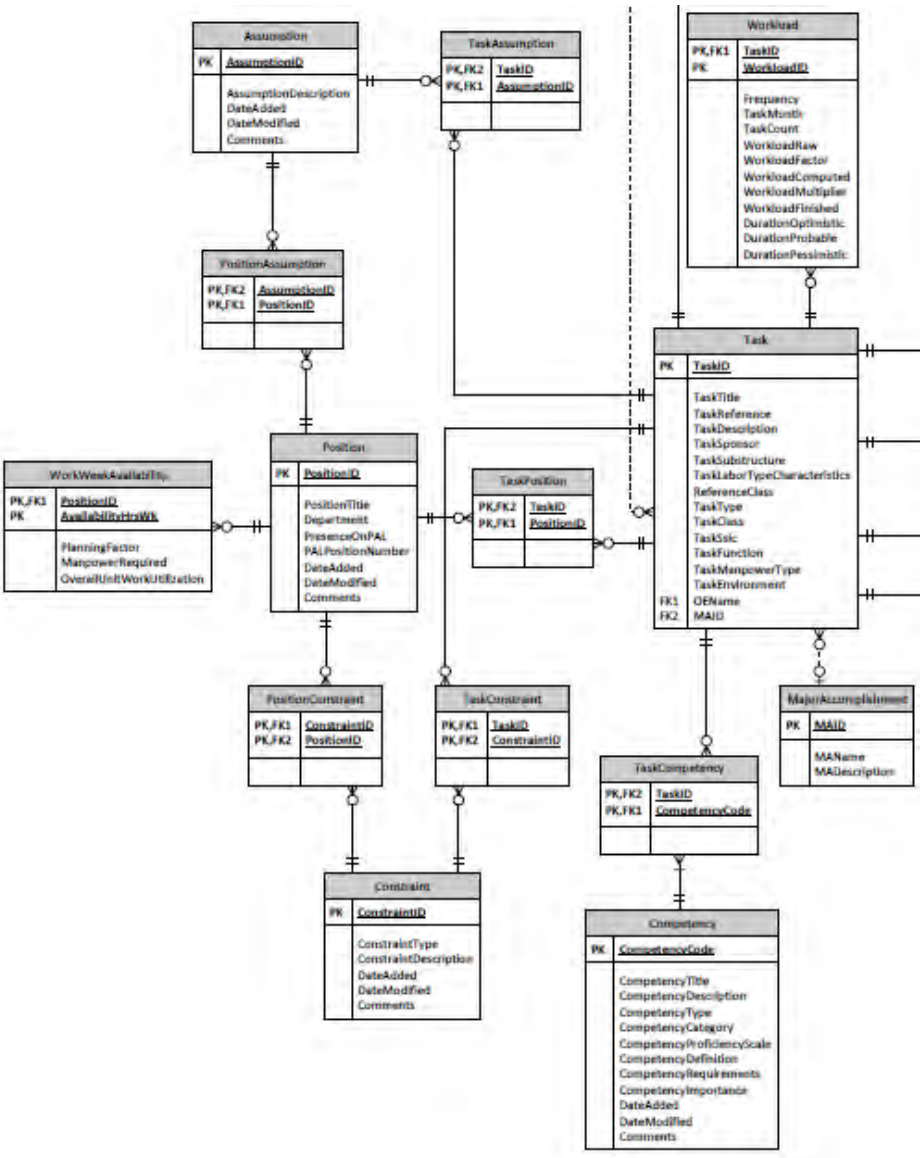

Figure 8. Work and Workload Information

Per SLMR manual, Volume III, competencies are supposed to be related to major accomplishments (Commandant, 2010a, p. 3-26). A relationship was drafted between the Task and Competency entities vice between the MajorAccomplishment and Competency entities as shown in Figure 9. This was done because not all task(s) rise to the level of a major accomplishment, but a particular competency or competencies may still be required to complete the task(s). Creating a relationship between the Task and

Competency entities will more thoroughly identify the competencies required to complete tasks and major accomplishments.

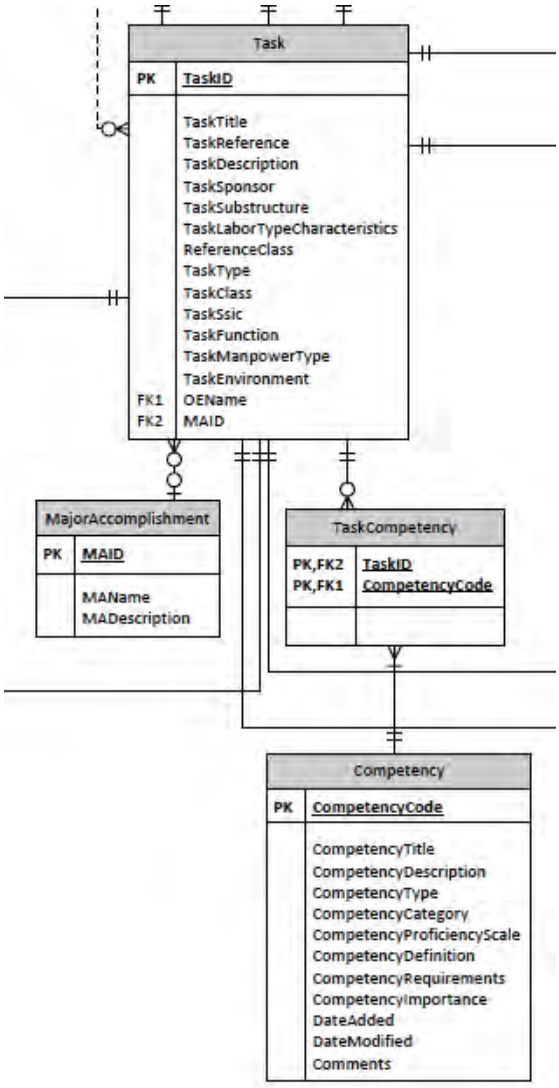

Figure 9. Competency Relationship

In the ERD, there is an Assumption entity and a GeneralAssumption entity. To alleviate any confusion between the two entities a short description follows. The Assumption entity applies to people and work or workload, and is related to the Position and Task entities as shown in Figure 8. The Assumption entity records published standards that influence the way and how much work is distributed to positions. The

GeneralAssumption entity provides background information, and is related to the MRA entity as shown in Figure 10. The GeneralAssumption entity influences the overall execution of the MRA.

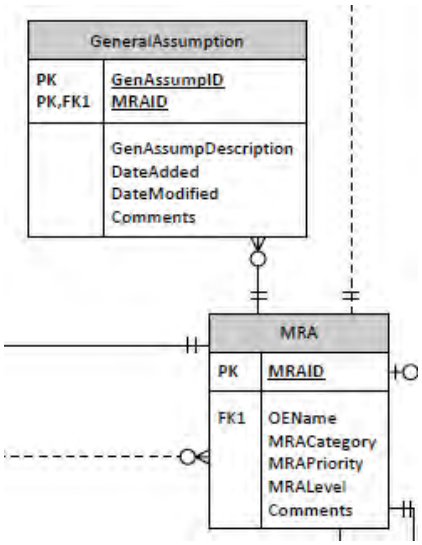

Figure 10. GeneralAssumption Entity

Organization information is found in the ERD in the OE, WorkCenter, and Option entities. OE is short for organizational element. An organizational element may be a unit or a portion of a unit. Work centers make up OEs, and OEs are collections of departments, divisions, branches, etc. The entity, WorkCenter is purposefully general. It should accommodate any OE's organization. Any ambiguity should be resolved with the attribute, WorkCenterDescription. The OE and WorkCenter entities are connected through the Task entity as shown in Figure 11.

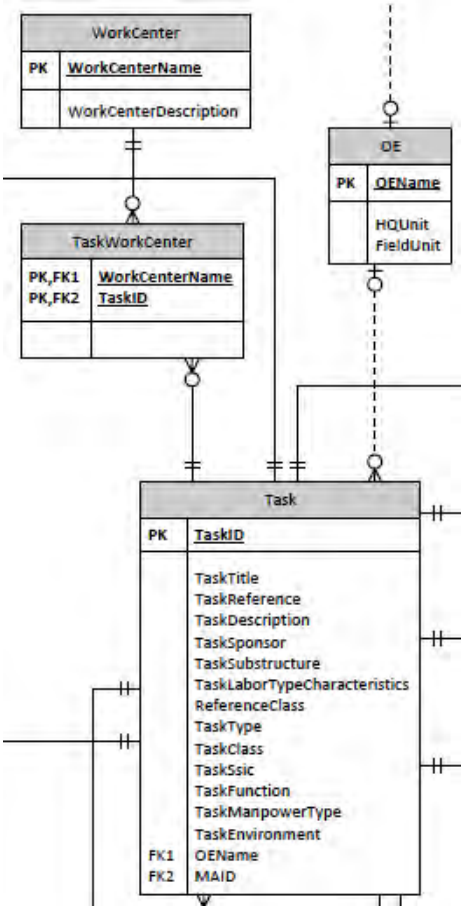

Figure 11. OE WorkCenter Relationship

The Option entity catalogs each manpower alternative. In an earlier ERD draft, an MRD entity existed, however, it was deleted because it did not host much information. Instead, MRD was added as an attribute to the Option entity as shown in Figure 12. The MRD attribute is binary. One of the options will be the MRD, and a simple binary data point will communicate which option is the MRD clearly.

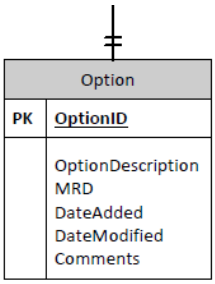

Figure 12. Option Entity

C. RELATIONAL DATABASE

Establishing an ERD ahead of the relational database made creating the relational database easy. The relational database was drafted in Microsoft Access 2013. The program is easy to use, however, not as user friendly as Microsoft Visio 2010. Creating tables and running queries, however, were particularly simple.

The most inconvenient features of Microsoft Access 2013 were key migration, establishing relationships, and print margins. Unlike Microsoft Visio 2010, primary keys did not automatically migrate as foreign keys from parent to child entities. Foreign keys needed to be manually added in Microsoft Access 2013. Also relationships had to be deliberately made. A primary key needed to be specifically linked to another primary or foreign key for a relationship to be established, whereas in Microsoft Visio 2010, the relationship line only needed to be dragged into the entities in general for the linkage to be made. These shortcoming with Microsoft Access 2013 made the ERD particularly valuable as a guide to accurately building the relational database. The last inconvenience managed with Microsoft Access 2013 was that the print margins were not visible on the relationship tab or the Relationship Report, and a tool did not exist to zoom in or out of these screens which made viewing the relational database in its entirety impossible.

The relational database was built in three steps: created tables or entities, established relationships, and inputted data. Creating the entities was easy. Establishing the relationships were more difficult. Several error messages populated the computer screen during the process. Most commonly, the error messages were resolved by editing the data type of the primary or foreign key, or by adding an associative entity. Primary

and foreign keys need to have the same data type in order to establish a relationship between them. Notable, Microsoft Visio 2010 has a much more extensive menu of data types than Microsoft Access 2013. Unlike the primary and foreign keys and the relationships, the data types do not replicate exactly from Microsoft Visio 2010 to Microsoft Access 2013. Adding an associative entity resolved specifically the indeterminate relationship error message.

Data type selection was a little tedious. Early on, AutoNumber was used for many of the artificial primary keys. Two issues were discovered in doing this. First, Microsoft Access 2013 only permitted one attribute per entity to have an AutoNumber data type. This was problematic as primary keys migrant, and often migrated to entities that already had AutoNumber data type attributes. Next, AutoNumber generated a single, non-unique numbering scheme: one, two, three, four, etc. This was not ideal because if many attributes had an AutoNumber data type then their numbering scheme would be identical and eventually confusing when synthesizing data. Ultimately the Short Text data type was the default data type, because voluminous alphanumeric information was inputted. The Number data type did not allow any alpha characters.

As my last step prior to testing, data was inputted. Data from the Regional Dive Locker Pacific and the WTGB 140’ (Bay) Class Icebreaking Harbor Tug MRAs was used. Some made-up information was also inputted. Specifically the MRA data helped to validate that the identification of entities and attributes was thorough. The compilation of data is not intended to yield any specific result, but merely exists to facilitate test and evaluation of the relational database.

Inputting data to the relational database served as a premature evaluation. It helped me identify areas where data was lacking and redundancies. The datasheet view was easy to navigate, and observe where edits were required. For example in the Constraint entity, each type of constraint was listed as an attribute but during data entry edited to a single attribute, ConstraintType.

D. DESCRIPTION OF VERIFICATION AND VALIDATION

The objective of this project was to build a data repository, and to be able to summarize the data within the repository in reports and spreadsheets similar to the products in MRA reports. The relational database was tested using queries. Specifically, the MFPU MRA Report was reviewed, and similar reports were successfully produced. On average, the relational database can produce approximately 70% of the spreadsheets and reports found in MRAs. A combination of real and fictitious data was used in testing, so the results reflected in the generated spreadsheets and reports below are fictitious.

The MFPU MRA Report listed the project's assumptions as shown in Figure 13. This product was replicated with simulated data as shown in Figure 14. Figure 14. specifically demonstrates the repository capability of the relational database in that it reflects all project assumptions entered in the relational database by MRAID and OE name.

6.1 Project Assumptions

The following assumptions were integrated into the analysis:

- The higher the degree of analytical rigor, the more accurate the MRD; the more accurate the MRD, the better the MRD helps Sponsors manage resources, requirements, and risk.
- The MRA Sponsor will provide a Sponsor's Representative that will be readily available to facilitate all aspects of the MRA.
- The MRA Sponsor will provide extant data described in the Sponsor's Guidebook and identified in the Alignment Meeting or by SMEs.
- The MRA Team will have reasonable access to SMEs, APs, and other key personnel, and will coordinate requests, meetings, briefs, conferences, and interviews with the MRA Sponsor.
- Manpower workload demand for an OE is determined by mission requirements, operating environment, asset configuration, and equipment, and is expressed as average man-hours/week.
- Budgetary constraints, allowances for personnel in a transient/leave status, inadequately trained personnel, habitability constraints, and abnormal operational demands resulting from military contingencies and emergencies are excluded. In essence, the MFPU is fully funded, all MFPU staff are full-trained and fully-qualified when they arrive for the billet they are assigned and the MFPU will operate under normal circumstances.

Figure 13. MFPU MRA Report Project Assumptions

MRAID	OEName	AssumptionDescription
MRA001	Bay Class Icebreaking Harbor Tug	The technical estimates of time required to accomplish work, broken down into
MRA001	Bay Class Icebreaking Harbor Tug	Unless otherwise indictated, only work normally assigned and completed by W
MRA001	Bay Class Icebreaking Harbor Tug	All relevent extant data and information was presented to the MRD analysts.
MRA001	Bay Class Icebreaking Harbor Tug	The WTGB world of work is determined by its mission requirements.
MRA001	Bay Class Icebreaking Harbor Tug	WTGB missions will not change in the foreseeable future.
MRA002	Regional Dive Locker Pacific	The technical estimates of time required to accomplish work, broken down into
MRA002	Regional Dive Locker Pacific	Unless otherwise indictated, only work normally assigned and completed by W
MRA002	Regional Dive Locker Pacific	All relevent extant data and information was presented to the MRD analysts.
MRA002	Regional Dive Locker Pacific	The WTGB world of work is determined by its mission requirements.
MRA002	Regional Dive Locker Pacific	WTGB missions will not change in the foreseeable future.
MRA003	Maritime Force Protection Unit	The technical estimates of time required to accomplish work, broken down into
MRA003	Maritime Force Protection Unit	Unless otherwise indictated, only work normally assigned and completed by W
MRA003	Maritime Force Protection Unit	All relevent extant data and information was presented to the MRD analysts.
MRA003	Maritime Force Protection Unit	The WTGB world of work is determined by its mission requirements.
MRA003	Maritime Force Protection Unit	WTGB missions will not change in the foreseeable future.

Figure 14. Relational Database Assumption Output

Finished workload is computed using the equation, workload finished (WL_F) = workload computed (WL_C) x workload multiplier (WL_M). These calculations are typically performed within the Work Matrix for an MRA. The relational database, however, has the capability to store all the required data and then with the application of code perform necessary mathematical computations. Although writing code was outside the scope of this project, all the required data is available in the relational database as shown in Figure 15. For the purposes of visual representation, WL_F was manually calculated.

WorkloadComputed	WorkloadMultiplier	WorkloadFinished
20.6	1.13	23.4
1.99	1.13	2.2
20.6	1.13	23.4
11.3	1.13	12,8
1.99	1.13	2.2
*		

Figure 15. Relational Database Workload Finished Data

The MFPU MRA Report summarized the competencies used in the MRA as shown in Figure 16. The summary was imitated with simulated data as shown in Figure 17.

Competency Id	Competency Type	Competency Title	Competency Description
YNADM	Personnel	Administrative Specialist	Demonstrates knowledge of USCG administrative policies, procedures, and correspondence.
GM02	Weapons	Armorer	The GM02 Armorer Competency will authorize members a higher degree of maintenance responsibility by allowing them to repair small arms beyond the operator level.
SPCSVBCM	Boat Ops	BCM SPC SV	BCM safely perform their duties under the supervision of a COXN. They stand helm, lookout, towing watches, and anchor watch. They also rig towing and mooring lines, act as the surface swimmer, administer first aid, and operate damage control equipment. They have knowledge of general boat operations and the local operating area.
CRWSPC	Boat Ops	BCM SPC-LE	Crewmembers safely perform their duties under the supervision of a coxswain. They stand helm, lookout, towing watches, and anchor watch. They also rig towing and mooring lines, act as the surface swimmer, administer first aid, and operate damage control equipment. They have knowledge of general boat operations and the local operating area.

Figure 16. MFPU MRA Report Competency List

CompetencyCode	CompetencyType	CompetencyTitle	CompetencyDescription
WTGB_001	Afloat Operations	CMPLUS Maintenance	501753 CMPLUS Maintenance
WTGB_002	Afloat Operations	Team Coordination Training-Cutter OPS	500686 Team Coordination Training-Cut
WTGB_003	Afloat Operations	ATON Deck Supervisor	230015 ATON Deck Supervisor
WTGB_004	Afloat Operations	Minor Aids Maintenance	500622 Minor Aids Maintenance

Figure 17. Relational Database Competency Output

The capability to compare manpower requirements as determined by an MRA and current manning informs the drafting of options toward the end of an MRA. The MFPU MRA report made such a comparison as shown in Figure 18. The comparison was replicated with simulated data as shown in Figure 19. however, a binary attribute, PresenceOnPAL was engineered to communicate whether the position already existed on the PAL or if it represented a gap. If the position exists on the PAL, the position number is found adjacent to the binary attribute.

MFPU PAL versus MRD Comparison								
Org Element	**MFPU PAL**			**BANGOR MRD**			**Kings Bay MRD**	
	PAL Position Title	**Rank**	**Qty**	**MRD Position Title**	**Rank**	**Qty**	**Rank**	**Qty**
COMMAND	COMMANDING OFFICER	CDR	1	Commanding Officer	CDR	1	CDR	1
	EXECUTIVE OFFICER	LCDR	1	Executive Officer	LCDR	1	LCDR	1
	SILVER BADGE CMD CHIEF	POCM	1	Command Master Chief	POCM	1	POCM	1

Figure 18. MFPU MRA Report PAL vs. MRD Comparison

WorkCenterName	PositionID	PositionTitle	PresenceOnPAL	PALPositionNumber
Boat Division	WTGB - BM1	Deck Division Head	☑	1234567
Boat Division	WTGB - BM2	Assistant Navigator	☐	
Boat Division	WTGB - BM3	Deck Division Lead Petty Officer	☑	3456789
Boat Division	WTGB - BMC	Operations Department Head/Navigator	☑	4567891
Boat Division	WTGB - SA/SN	Deck Division	☑	5678912

Figure 19. Relational Database PAL vs. MRA Comparison

E. CHAPTER SUMMARY

This evolution confirms that the implementation of a relational database would yield efficiency in manpower requirements determination. Critical in the development process is the draft of an ERD. The ERD is an invaluable guide to building the relational database. That said, test and evaluation of the relational database begins almost immediately. Microsoft Access 2013 sends error messages when establishing relationships, inputting data, and running queries, so the opportunity exists throughout development to continually improve the relational database. It is an iterative process.

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IV. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

The United States Coast Guard (USCG) executes 11 missions around the clock and the world, and in varying threat and weather conditions dictating an agile and responsive workforce. Therefore, determining manpower requirements and getting the right people, in the right places, at the right times, with the right skills is an ongoing and complex process. Too few or underqualified people may adversely impact safety, readiness, and mission execution. Too many or overqualified people may siphon funding from other priorities.

The USCG and Navy processes for determining manpower requirements are similar, however, some fundamental differences exist. For example, the USCG has adopted many Navy processes as its own, yet has centralized the authority for shore manpower requirements determination unlike the Navy. Regardless of similarities and differences, there is benefit to the USCG and the Navy remaining appraised of the other service's best practices and lessons learned. Exchange between the services will contribute to optimizing their respective manpower requirements determination processes.

The intent of a Manpower Requirement Determination Automated Information System (MRD AIS) is to improve the accuracy of determining manpower requirements, alleviate time intensive manual processes, standardize manpower analysis, increase transparency, bolster adaptability, optimize manpower allocation, and identify alternative staffing solutions. The purpose of this study was to demonstrate the potential value in implementing a MRD AIS in the USCG. Modeling the factors that contribute to determining manpower requirements in an entity-relationship diagram (ERD), and subsequently testing via a relational database confirmed that implementing a similar model and database would yield efficiency in manpower requirements determination.

B. CONCLUSIONS AND RECOMMENDATIONS

The primary research question is:

What are the data requirements to determine Coast Guard manpower requirements?

Conclusion: As a result of a thorough review of the USCG Staffing Logic and Manpower Requirements (SLMR) Manuals, Volumes I–IV; associated job aids and templates, and recent MRAs for the following organizational elements: Judge Advocate General (JAG) Program, Maritime Force Protection Unit (MFPU), Regional Dive Locker Pacific, and WTGB 140' (Bay) Class Icebreaking Harbor Tug, a comprehensive list of entities, attributes, and their respective definitions was drafted. Nouns describing people, work or workload, and organization were the focal points to determine data requirements. This information is consolidated in the Data Dictionary located in Appendix A.

Recommendation: The USCG Manpower Requirements Determination Division ought to commit to the full implementation of an MRD AIS. This type of tool, consistent with this project's findings, will yield efficiencies associated with MRD. The potential implementation supports the nature of twenty-first century threats and fiscal challenges, getting the right people, to the right places, at the right times, with the right skills. The entities, attributes, and relationships identified in this research should be reviewed to either revise the MRD AIS delivered by the contractor or used as the foundation for a new MRD AIS.

The secondary research question is:

How does the Navy determine manpower requirements, and how does their process inform this research?

Conclusion: The Navy uses site visits and Navy Manpower Requirements Systems (NMRS) to determine Fleet manpower requirements, and 34 individual, decentralized Budget Submitting Offices to determine manpower requirements for their respective programs.

The USCG and Navy processes for determining manpower requirements are similar in regard to workload measurement and Fleet manpower requirements determination. The greatest similarity is that the USCG and the Navy use NMRS to pair workload information, specifically workload hours, with occupational knowledge, skills, and abilities to quantify and qualify Fleet manpower requirements. NMRS produces a recommended manpower mix based on validated workload information. The USCG is able to use this Navy product, because the nature of work between the services is comparable.

Recommendation: The USCG Manpower Requirements Determination Division should continue to leverage its relationship with the Navy Analysis Manpower Center (NAVMAC), and its use of NMRS. Currently, NMRS appears to be a most capable tool at the USCG's disposal. Synergy between the USCG Manpower Requirements Determination Division and NAVMAC may contribute to optimizing both organizations' MRD processes.

C. FURTHER RESEARCH

A team of students from acquisition, computer science, manpower, and systems engineering curriculums and USCG Headquarters subject matter experts should refine and advance the work completed within this project. Particular capabilities that should be added to this project's database include code to perform mathematical computations and to yield summary data, work and workload distribution, and optimization capabilities. Interface with other USCG databases including the Abstract of Operations System, the Training Management Tool, the Aviation Logistics Management Information System, and Direct Access may also be helpful. It is possible, however, that an MRD AIS may alleviate the need for one or more of these existing databases.

Another method to accelerate the USCG's implementation of an MRD AIS is to conduct research that would determine how NMRS would need to be modified to also contribute to determining shore manpower requirements. Ultimately, a standardized MRD AIS that would determine Fleet and shore manpower requirements would yield efficiency.

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APPENDIX A. DATA DICTIONARY

Entity	**Definition**	**Reference**
Contractor	A person hired by the Coast Guard to contribute to the completion of an MRA.	
Attribute	**Definition**	**Reference**
ContractorID	An alphanumeric code used to identify contractors.	
LastName	The contractor's last name.	
FirstName	The contractor's first name.	
ContractorOrganization	The organization for which the contractor works.	
ContractorContactNumber	The contractor's phone number.	
ContractorContactE-mail	The contractor's e-mail address.	

Entity	**Definition**	**Reference**
DivisionPersonnel	A Coast Guard member assigned to a division responsible for MRA completion.	
Attribute	**Definition**	**Reference**
EMPLID	A numeric code used to identify coast guard members.	
Rank	The member's rank.	
LastName	The member's last name.	
FirstName	The member's first name.	
Division	The division to which the member is assigned.	
Office	The office to which the member is assigned.	
Branch	The branch to which the member is assigned.	
ContactNumber	The member's contact number.	
ContactE-mail	The member's e-mail address.	

Entity	Definition	Reference
MRATeamMember	A coast guard member or contractor that works on one or more teams to accomplish MRA(s).	
Attribute	**Definition**	**Reference**
MRATeamMemberID	An alphanumeric code used to identify MRA team members.	
MRATeamID	An alphanumeric code used to identify MRA teams.	
MRAID	An alphanumeric code used to identify MRAs.	
ContractorID	An alphanumeric code used to identify contractors.	
EMPLID	A numeric code used to identify coast guard members.	
MRAPosition	The roles filled by members of the MRA team e.g., requestor, project manager, analyst, etc.	

Entity	Definition	Reference
MRATeam	The collection of Coast Guard members and contractors that work on respective MRAs.	
Attribute	**Definition**	**Reference**
MRATeamID	An alphanumeric code used to identify MRA teams.	
TeamName	The name of the MRA team.	

Entity	Definition	Reference
MRA	MRA is the manpower requirements analysis.	
Attribute	**Definition**	**Reference**
MRAID	An alphanumeric code used to identify MRAs.	
OEName	The name of the organizational element.	
MRACategory	An assignment given to an MRA request: A- directed, B - sponsor-contracted, C - periodic review, D - sponsor-requested, E - Modeling & simulation	(Commandant, 2010a, p. 2-4)
MRAPriority	A score yielded by the MRA Request Prioritization Decision Matrix that dictates the priority of an MRA within a category	(Commandant, 2010a, pp. 2-5 - 2-6)
MRA Level	The level of analytical rigor applied to an MRA: Level 1 - Manpower Estimate Report, Level 2 - Workload Consolidation, Level 3 - Workload Validation, Level 4 - Workload Observation	(Commandant, 2014, p. 3.C.1.)
Comments	Amplifying information provided in regard to the MRA.	

Entity	Definition	Reference
MRARequest	Coast Guard form 5310 that initiates a MRA.	
Attribute	**Definition**	**Reference**
MRARequestID	An alphanumeric code used to identify MRA requests.	
RequestDate	The date the MRA request was submitted.	
OEName	The name of the organizational element.	
OEType	Organizational element type e.g. DCMS/DCO staff element, district staff, operational unit, etc.	(Commandant, 2014, p. 3-1-43)
OEMRATrigger	The specific reason(s) that prompted the need for the analysis.	(Commandant, 2014, p. 3-1-35)
OEDateLastMRA	The last date an MRA was completed.	
OESize	The size of the organizational element.	
ImportanceToSponsor	The importance to the sponsor e.g., essential to mission readiness, aligns with strategic goals, etc.	(Commandant, 2014, p. 3-1-44)
MRAID	An alphanumeric code used to identify MRAs.	
RequestorOfficeName	The office in which the requestor works.	
Comments	Amplifying information provided in regard to the MRA.	

Entity	Definition	Reference
Requestor	The senior member that initiated the MRA request.	
Attribute	**Definition**	**Reference**
RequestorOfficeName	The office in which the requestor works.	
PrimaryPocRank	The primary point of contact's rank.	
PrimaryLastName	The primary point of contact's last name.	
PrimaryFirstName	The primary point of contact's first name.	
SecondaryPocRank	The secondary point of contact's rank.	
SecondaryPocLastName	The secondary point of contact's last name.	
SecondaryPocFirstName	The secondary point of contact's first name.	

Entity	Definition	Reference
OE	The subject of the MRA.	
Attribute	**Definition**	**Reference**
OEName	The name of the organizational element.	
HQUnit	Binary indication of whether or not the organizational element is a Coast Guard headquarters' unit.	
FieldUnit	Binary indication of whether or not the organizational element is a Coast Guard field unit.	

Entity	Definition	Reference
GeneralAssumption	General assumptions provide direction in regard to how the MRA should be executed.	
Entity	**Definition**	**Reference**
GenAssumpID	An alphanumeric code used to identify general assumptions.	
MRAID	An alphanumeric code used to identify MRAs.	
GenAssumpDescription	General assumption description.	
DateAdded	The date on which the assumption was added.	
DateModified	The date on which the assumption was modified.	
Comments	Amplifying information provided in regard to the general assumption.	

Entity	**Definition**	**Reference**
MDMBusinessRule	MDM Business Rules direct how the overall MRA should be executed.	
Attribute	**Definition**	**Reference**
RuleSet	Numeric code used to identify the MDM rule set.	
MRAID	An alphanumeric code used to identify MRAs.	
RuleDescription	MDM rule description.	

Entity	Definition	Reference
WorkCenter	A portion of an organizational element e.g., department, division, office, branch, etc.	
Attribute	**Definition**	**Reference**
WorkCenterName	The work center's name.	
WorkCenterDescription	A description of the work center.	

Entity	Definition	Reference
Workload	The activity of a body or mind which can be measured against standards in time, quantity or quality including but not limited to operation of equipment, watches, military duties, military assemblies, maintenance, administration, support, utility tasks, evolutions, training, supervision, job-related conversations, etc.	(Commandant, 2014, p. Glossary)
Attribute	**Definition**	**Reference**
TaskID	The alphanumeric code used to identify the task.	
WorkloadID	The alphanumeric code used to identify the workload.	
Frequency	Data field used to indicate the rate of occurrence for a work item.	(Commandant, 2010a, p. 3-16)
TaskMonth	Data field used to indicate the month or months in which the OE accomplishes the work (for quarterly, semi-annual, or annual work). This provides the ability to conduct a cyclical work/workload analysis during the modeling and simulation phase.	(Commandant, 2010a, p. 3-17)
TaskCount	Data field used to record the maximum number of times a work item is accomplished during a specified period. The count may be multiplied to include the number of persons involved. It may also be fractionalized for work with annual frequencies exceeding every 4 years for example .2 count with a frequency of annual would be every five years.	(Commandant, 2010a, p. 3-17)
WorkloadRaw	The knowledge base task mean.	(Commandant, 2010a, p. 3-50)
WorkloadFactor	A workload factor is an index or unit of measure that is consistently relatable to the work required to accomplish a specifically defined responsibility; e.g., the number of officers ably serviced by an assignment officer, or the number of personnel records ably serviced by a Yeoman.	(Commandant, 2010a, p. 5-8)

WorkloadComputed	OE workload computed is the workload for each task based on the workload minutes per week times the work count for each task performed at the OE.	(Commandant, 2010a, p. 3-52)
WorkloadMultipler	The workload multiplier is applied to workload computations to account for various process slowing events.	(Commandant, 2010a, p. 3-52)
WorkloadFinished	Workload finished is the workload with appropriately applied PF&D multiplier expressed in minutes per week for each OE task.	(Commandant, 2010a, p. 3-56)
DurationOptimistic	Data field that represents the most efficient time required to complete a single work item. Work Duration is recorded using selectable responses such as 5-10 minutes, 10-15 minutes, etc. If available selectable responses cannot adequately explain the duration of the work item the analyst should record the reason for this in the analyst notes column of the work matrix.	(Commandant, 2010a, p. 3-17)
DurationProbable	Data field that represents the most common time required to complete a single work item. Work Duration is recorded using selectable responses such as 5-10 minutes, 10-15 minutes, etc. If available selectable responses cannot adequately explain the duration of the work item the analyst should record the reason for this in the analyst notes column of the work matrix.	(Commandant, 2010a, p. 3-17)
DurationPessimistic	Data field that represents the least efficient time required to complete a single work item. Work Duration is recorded using selectable responses such as 5-10 minutes, 10-15 minutes, etc. If available selectable responses cannot adequately explain the duration of the work item the analyst should record the reason for this in the analyst notes column of the work matrix.	(Commandant, 2010a, p. 3-17)

Entity	Definition	Reference
Task	Task and work item are synonymous, but task is used to remain consistent with the Accomplishment Based Curriculum Development system. Basic identification of work accomplished or services performed. Tasks should be easy to identify, convenient for obtaining productive count, and usable for scheduling, planning, and costing.	(Commandant, 2014, p. Glossary)
Attribute	**Definition**	**Reference**
TaskID	The alphanumeric code used to identify the task.	
TaskTitle	A descriptive title of the work item	(Commandant, 2010a, p. 3-13)
TaskReference	A unique alphanumeric reference for each work item	(Commandant, 2010a, p. 3-13)
TaskDescription	A more detailed description of the work item	(Commandant, 2010a, p. 3-13)
TaskSponsor	The program manager for the specific work item being described for example CG-00H for Civil Rights related work items	(Commandant, 2010a, p. 3-13)
TaskOESubstructure	A descriptive field that points to specific work center within the OE in which the work item is performed.	(Commandant, 2010a, p. 3-13)
TaskLaborTypeCharacteristics	Information about the work item that may indicate the use of one type of manpower over another for example the work item is military essential and therefore requires military personnel to complete it.	(Commandant, 2010a, p. 3-13)
ReferenceClass	Work is categorized by the source from which it was discovered, as either documented (work base on official doctrine, directives, or other authoritative, written sources of information) or undocumented (work based on unofficial or informal practices, policies or rules that must be adjudicated during the MRA process in order to be included in the manpower determinants model).	(Commandant, 2010a, p. 3-14)

TaskType	Used to classify work/workload as either direct (work conducted to accomplish the OE's mission(s), function(s) and goal(s)) or indirect (work that does not directly support an OE's assigned mission(s), function(s), and goal(s), but is performed in order to manage organizational, personnel, and capital assets)	(Commandant, 2010a, p. 3-14)
TaskClass	Used to group work items into designated categories for example SAR (search and rescue - direct work), SML (supervision, management, and leadership - indirect work), COL (collateral duties - indirect work), TRA (training - indirect work), and HRM (human resource management - direct work).	(Commandant, 2010a, p. 3-14)
TaskSsic	A broad function category that describes the work item in terms of the most applicable standard subject identification code (SSIC) for the specific type of referenced work.	(Commandant, 2010a, p. 3-14)
TaskFunction	A more detailed description of documented work items, using the noun title of the SSIC.	(Commandant, 2010a, p. 3-14)
TaskManpowerType	Identifies the particular labor source linked to a work item (military active/reserve, civilian, contractor, or volunteer) that generally has a common set of workforce availability and constraints.	(Commandant, 2010a, p. 3-15)
TaskEnvironment	Identifies the primary place that the work item is performed for example at sea or inport, on or off watch, etc.	(Commandant, 2010a, p. 3-15)
OEName	The name of the organizational element.	
MAID	The alphanumeric code used to identify the major accomplishment.	

Entity	Definition	Reference
Position	A designated placeholder as indicated in the personnel allowance list or determined to be necessary per an MRA. A position represents all jobs, duties, skills, responsibilities, and supervisory relationships assigned to an employee.	(Commandant, 2014, p. Glossary)
Attribute	**Definition**	**Reference**
PositionID	The alphanumeric code used to identify the position.	
PositionTitle	The title of the position.	
PresenceOnPAL	Binary indication of whether or not the position is on the personnel allowance list.	
PALPositionNumber	The position number on the personnel allowance list.	
DateAdded	The date on which the position was added.	
DateModified	The date on which the position was modified.	
Comments	Amplifying information provided in regard to a position.	

Entity	**Definition**	**Reference**
Rank	A particular position achieved within a hierarchy.	
Attribute	**Definition**	**Reference**
RankAbbreviation	The rank's abbreviation.	
RankName	The name of a rank.	

Entity	**Definition**	**Reference**
Rate	The specialty of an enlisted member.	
Attribute	**Definition**	**Reference**
RateAbbreviation	The rate's abbreviation.	
RateName	The name of a rate.	

Entity	Definition	Reference
WorkWeekAvailability	Coast Guard human capital management processes use work week availability as planning factors help define manpower needed to accomplish identified missions and associated work requirements for various organizational elements. Standard workweeks are guidelines for sustained personnel use and should not be viewed as binding on a command's ability to manage its unit workforce.	(Commandant, 2014, p. 3-1-21)
Attribute	**Definition**	**Reference**
PositionID	The alphanumeric code used to identify a position.	
AvailabilityHrsWk	The number of hours per week each labor source is available to dedicate to productive work activities.	(Commandant, 2010a, p. 3-24)
Planning Factor	A conversion factor applied to workload raw for each task.	(Commandant, 2010a, p. 3-50)
Manpower Required	The number and types of positions required to successfully accomplish all of the work assigned to the OE.	(Commandant, 2010a, p. 4-3)
Overall Unit Work Utilization	Range at which a position requirement or set of requirements in an OE may be either not fully utilized, likely to be optimally utilized, at or near maximum load and exceed target load, or exceed maximum load and are unlikely to meet workload demands.	(Commandant, 2010a, p. 4-7)

Entity	Definition	Reference
Assumption	Assumptions are characteristics about an OE, its mission and workers that must be assumed to provide a starting point from which to determine the appropriate manning.	(Commandant, 2010a, p. 3-25)
Attribute	**Definition**	**Reference**
AssumptionID	The alphanumeric code used identify an assumption.	
AssumptionDescription	The description of the assumption.	
DateAdded	The date on which the assumption was added.	
DateModified	The date on which the assumption was modified.	
Comments	Amplifying information provided in regard to an assumption.	

Entity	Definition	Reference
Constraint	Business rules that must be taken into account when identifying work requirements or assigning workload to a particular labor force in the MRA process. Represent statutory or policy level limitations on the amount of work certain Coast Guard personnel can do, or the type of workers assigned to do the work. Factors act as filters through which final manpower options are modeled.	(Commandant, 2014, p. Glossary)
Attribute	**Definition**	**Reference**
ConstraintID	The alphanumeric code used to identify the constraint.	
ConstraintType	Work designation, workforce type, work location, operational status, specialty/rate type, rank/paygrade type, cutter employment standards, watchstanding duty requirements, or crew endurance factors.	(Commandant, 2010a, pp. 3-19 - 3-24)
ConstraintDescription	The description of the constraint.	
DateAdded	The date on which the constraint was added.	
DateModified	The date on which the constraint was modified.	
Comments	Amplifying information provided in regard to a constraint.	

Entity	**Definition**	**Reference**
MajorAccomplishment	Output of behavior that has direct value to the goals of the job and the organization.	(Commandant, 2014, p. Glossary)
Attribute	**Definition**	**Reference**
MAID	The alphanumeric code used to identify the major accomplishment.	
MAName	The name of the major accomplishment.	
MADescription	The description of the major accomplishment.	

Entity	Definition	Reference
Competency	Knowledge, skills, abilities, personal characteristics, qualifications, training, education, licenses/certifications, and prior assignments needed to perform work to a predetermined, measurable standard.	(Commandant, 2014, p. Glossary)
Attribute	**Definition**	**Reference**
CompetencyCode	An alphanumeric code up to eight characters long that uniquely identifies a competency in DA. This code is established when the competency is created in DA. Users will only see this code when creating ad hoc competency queries.	(Commandant, 2005, p. 2-3)
CompetencyTitle	The title of the competency.	
CompetencyDescription	An alphanumeric acronym or abbreviation up to 10 characters long that provides enough information to allow a person to identify a competency uniquely. Used for code validation when creating ad hoc competency queries.	(Commandant, 2005, p. 2-3)
CompetencyType	The assigned functional or mission area where the requirement of the competency is concentrated; i.e., Afloat Operations; Aviation; Command, Control, Communications, Computers and Information Technology (C4IT). Competencies may be assigned multiple types.	(Commandant, 2005, p. 2-3)

CompetencyCategory	The classification of a competency establishing the kind of competency; knowledge, skill, ability, or other (behavior).	(Commandant, 2005, p. 2-3)
CompetencyProficiencyScale	The proficiency rating scale, displayed as "Rating" in DA is used to establish the level of competence. This scale applies to both persons and positions. For the individual member, it describes the proficiency level the person has achieved. For a position, it describes the level of proficiency needed to be successful in the position. The associated levels may vary with each competency. Levels typically include: None, Little, Good, Very Good, and Expert.	(Commandant, 2005, p. 2-3)
CompetencyDefinition	The complete description of the competency. The competency definition is written in a specific manner, describing what the holder of the competency can do.	(Commandant, 2005, p. 2-3)
CompetencyRequirements	The complete listing of all qualification requirements (schools, Personnel Qualification Standard [PQS], time, prerequisite competencies, etc.), and any restriction on who the competency may be assigned to (military only, civilian, enlisted, Auxiliary, or pay grade).	(Commandant, 2005, p. 2-3)
CompetencyImportance	This field is used to establish the desired/required need for the competency for an assigned position. This characteristic is only used when a competency is assigned to a position. See Table 2-1 for importance descriptions.	(Commandant, 2005, p. 2-3)
DateAdded	The date on which the competency was added.	
DateModified	The date on which the competency was modified.	
Comments	Amplifying information provided in regard to a competency.	

Entity	**Definition**	**Reference**
Option	A result from the modeling effort.	
Attribute	**Definition**	**Reference**
OptionID	The alphanumeric code used to identify an option.	
OptionDescription	The description of the option.	
MRD	Binary indication of whether or not a particular option is the MRD.	
DateAdded	The date on which the option was added.	
DateModified	The date on which the option was modified.	
Comments	Amplifying information in regard to an option.	

Entity	**Definition**	**Reference**
Allowance	A standard applied to workload to adjust for factors including working conditions, physical & mental exertion requirements, etc.	(Commandant, 2010a, p. 3-52)
Attribute	**Definition**	**Reference**
AllowanceID	An alphanumeric code used to identify an allowance.	
AllowanceType	The specific type of personal, fatigue, or delay consideration.	
Allowance	The name of the specific allowance.	
WorkFacility (work location)	The performance environment, for example boat, cutter, shore facility	MRA PF&D Template
WorkCategory	Work activity or series of work actions for example evolutions, general administration, maintenance, training, watchstanding	MRA PF&D Template
WorkCondition (work environment)	General physical environment in which the work is performed for example hanger, moored, office, underway	MRA PF&D Template
DateAdded	The date on which the allowance was added.	
DateModified	The date on which the allowance was modified.	
Comments	Amplifying information provided in regard to an allowance.	

Entity	Definition	Reference
ReferenceDocument	A document that directs or provides amplifying information in regard to an organizational element's work or workload.	
Attribute	**Definition**	**Reference**
Title	The title of the reference document.	
DhsDODSsic	If applicable, the standard subject identification code used to identify a reference document.	
PublicationDate	The date the reference document was published.	
PublicationOrganization	The organization that published the reference document.	

Entity	**Definition**	**Reference**
Survey	A series of questions that facilitate work measurement.	
Attribute	**Definition**	**Reference**
SurveyID	An alphanumeric code used to identify the survey.	
SurveyDate	The date the survey was conducted.	
SurveyAudience	A description of to whom the survey was distributed.	

Entity	**Definition**	**Reference**
SurveyQuestion	A question asked on the survey.	
Attribute	**Definition**	**Reference**
SurveyQuestionID	An alphanumeric code used to identify the survey question.	
SurveyQuestionDescription	A representation of the question asked on the survey.	
Survey ID	An alphanumeric code used to identify the survey.	

Entity	**Definition**	**Reference**
SurveyAnswer	The answer provided to a survey question.	
Attribute	**Definition**	**Reference**
SurveyQuestionID	An alphanumeric code used to identify the survey question.	
SurveyAnswerID	An alphanumeric code used to identify the survey answer.	
SurveyAnswer	The response provided to the survey question.	
RespondentNumber	A numeric code assigned to survey respondents other than an employee ID. This code facilitates anonymity of survey respondents, but allows summary statistics to be tied to survey respondent demographics including rank and rate.	

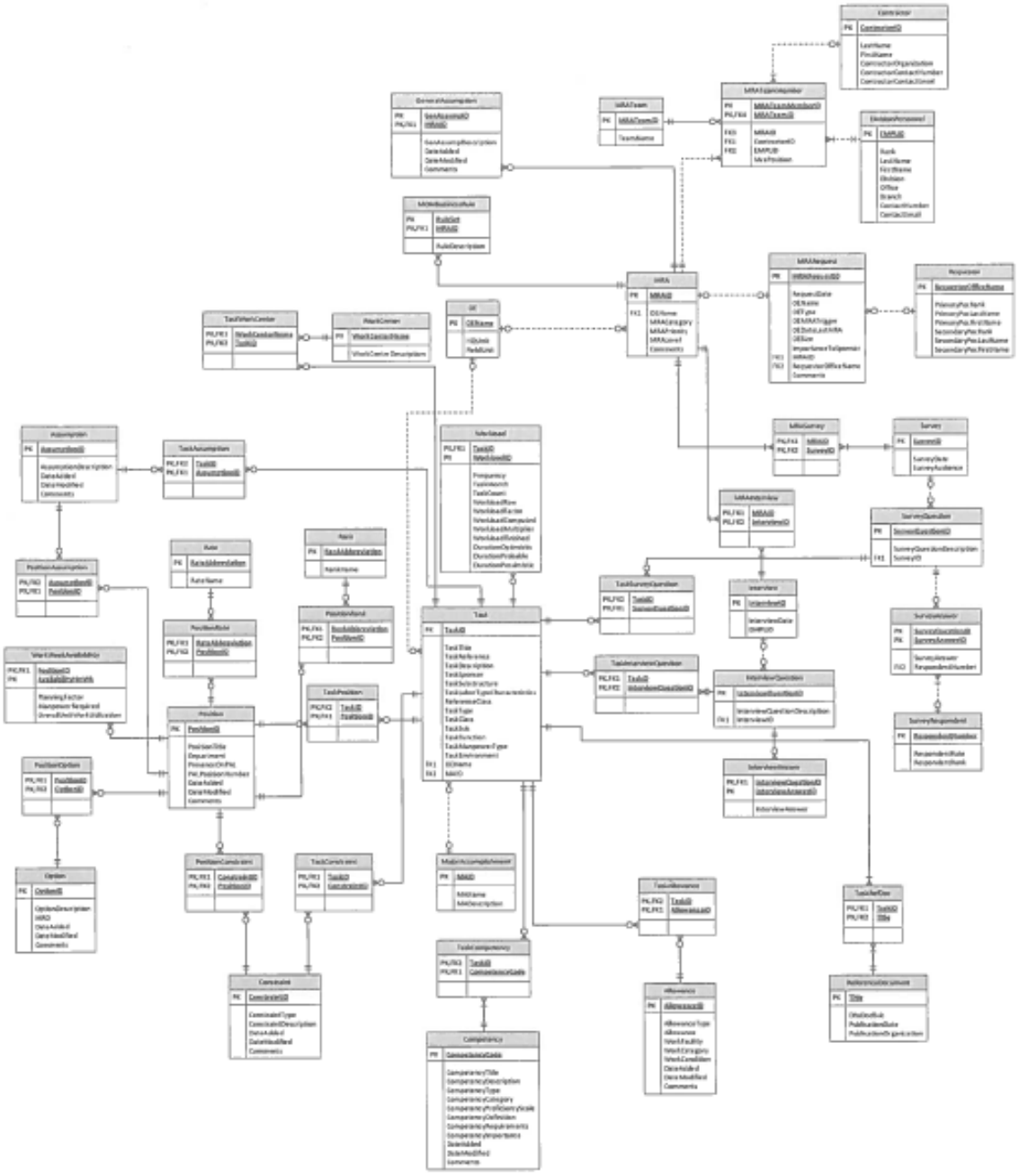
Entity	**Definition**	**Reference**
SurveyRespondent	A person that responds to a survey.	
Attribute	**Definition**	**Reference**
RespondentNumber	A numeric code assigned to survey respondents other than an employee ID. This code facilitates anonymity of survey respondents, but allows summary statistics to be tied to survey respondent demographics including rank and rate.	
RespondentRate	The rate of the survey respondent.	
RespondentRank	The rank of the survey respondent.	

Entity	Definition	Reference
Interview	A verbal exchange between a member at the organizational element being analyzed and an MRA team member to facilitate work measurement.	
Attribute	**Definition**	**Reference**
InterviewID	An alphanumeric code used to identify the interview.	
InterviewDate	The date the interview was conducted.	
EMPLID	A numeric code used to identify coast guard members.	

Entity	**Definition**	**Reference**
InterviewQuestion	A question asked during the interview.	
Attribute	**Definition**	**Reference**
InterviewQuestionID	An alphanumeric code used to identify the interview question.	
InterviewQuestionDescription	A representation of the question that was asked during the interview.	
InterviewID	An alphanumeric code used to identify the interview.	

Entity	**Definition**	**Reference**
InterviewAnswer	The answer to an interview question.	
Attribute	**Definition**	**Reference**
InterviewQuestionID	An alphanumeric code used to identify the interview question.	
InterviewAnswerID	An alphanumeric code used to identify the interview answer.	
InterviewAnswer	The response to the interview question.	

APPENDIX B. ENTITY-RELATIONSHIP DIAGRAM



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